Advancing Carbon Data Collection Maturity

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Why it matters?

1.Carbon Reporting is not an easy task

- Huge manual effort to collect carbon actuals
- Lack of trust in carbon actuals data
- Difficult to generate meaningful insights currently

2. Data concerns across the value chain

- Lack of data; Lack of data consistency

3. Alignment with PAS 2080: 2023

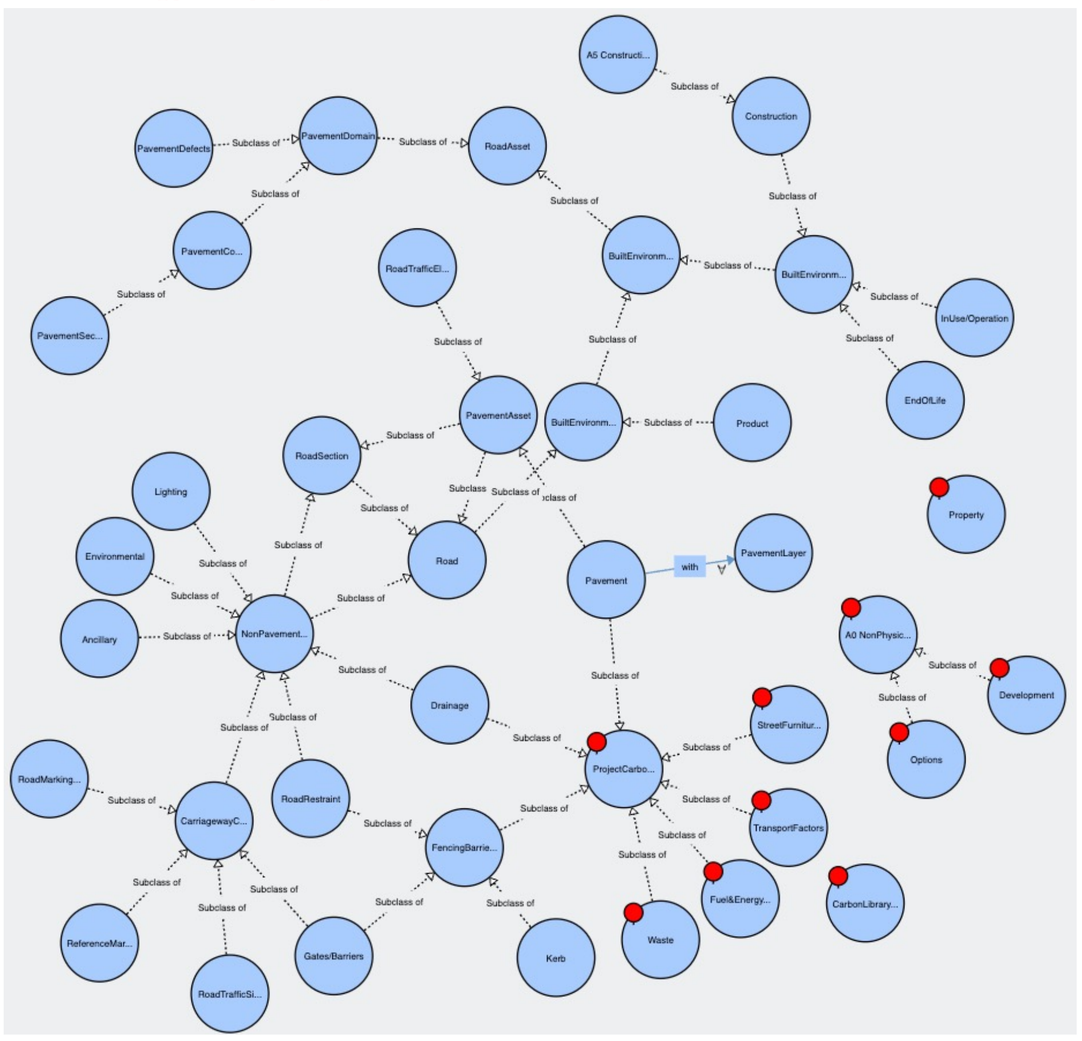
- Consistent data across the value chain is required
- But how this consistency could be achieved and embedded in infrastructure projects is not set out

Project Objectives

- Develop an industry-based **carbon data model** (data ontology, requirements, structure, protocol) to collect and share carbon data across supply chain and across life cycle
- Develop an **intelligent carbon management system framework** and **proof-of-concept**
- Increase **the trustworthiness, automation, and timeliness of carbon data** using data science techniques and digital technologies (BIM/digital twin, Digital Product Passport, IoT, ERP...)

Research Outcome: Carbon Data Model = 1 Data Ontology + 2 Data requirements + 3 Data structure

1. Ontology Mapping with ADMM and NH carbon tool



2. Carbon data requirements

Product	Process	Project	Asset	User
Actual used quantity	Carbon in transportation	Material carbon	Actual carbon over the lifespan of the asset	Journey distance
(Specific) Carbon factor	Carbon in unloading		Whole life carbon emission avoided	
Actual reused quantity	Carbon in construction	Design emissions		
Actual recyled quantity	Carbon in site management	Construction emissions		
Acutual waste quantity	Carbon in material recycling	Maintenance emissions		
	Carbon in waste treatment	Operation emissions		
	Carbon in maintenance	End user emissions		
	Carbon in operation	Reduction of CO2e per m2/km		
		Intervention cost /carbon	Carbon intensity per user per km	
		Recycled materials quantity	Pre/Post carbon per km Pre/Post carbon per km /vehicle	
		Quantity of waste	Comparable data on scheme vs. scheme CO2e	

3. Standardised carbon data structure

ProductFootprint (pf) | 8

- Identification
- Creation and update timestamps
- Status (active/deprecated)
- Validity period
- Data owner information
- Product details
- Carbon footprint details (pcf)
- Data model extensions

ProductOrSectorSpecific Rule | 2

- Operator (ProductOrSectorSpecificRuleOperator, otherOperatorName)
- Rule used (ruleNames)

Carbon Footprint (PCF) | 16

- Declared unit
- Amount per unit
- Various carbon footprint values with breakdown by source
- Characterization factors used
- Standards applied
- Biogenic accounting methodology
- Boundary process descriptions
- Reference period
- Geographic location
- Secondary emission factors used
- Percentage and rationale for excluded emissions
- Packaging emissions
- Allocation and uncertainty
- Assurance details (assurance)
- Share of primary data in percent
- Data quality indicators

DataQualityIndicators | 2

- Percentage of PCF included in the data quality assessment (coveragePercent)
- Quantitative data quality rating (DQR) (technologicalDQR, temporalDQR, geographicalDQR, completenessDQR, reliabilityDQR)

Assurance | 6

- Whether the CarboFootprint has been assured (assurance)
- Level of granularity of the emissions data assured (coverage, level, boundary)
- Assurer information (providerName)
- Date of assurance (completedAt)
- Standard used (standardName)
- Additional comments (comments)

EmissionFactorDS | 2

- Name
- Version

Note 1: The ontologies generated from PAS2080 data categories, NH ADMM (asset data management manual), carbon tool and newest carbon library has been mapped. This figure only shows a high-level of the ontology for visualisation. The classes with red dots are from carbon tool and carbon library, many of them are not connected with PAS2080 and ADMM, which causes inconsistency and lack of comprehensiveness in carbon data collection. This mapped ontology will address these issues.

Note 2: The carbon data requirements were collected from the Design-Thinking workshop on carbon data collection methodology in Jan 2024. The categories are suggested by buildingSmart UK Sustainability working group. A detailed data mapping has been conducted.

Note 3: The data structure follows *Logic data model in WBCSD PCF Data Exchange Protocol*.

Next step- Use case to test the methodology

Call for further support to test this methodology in use cases!

- **Work package 1** - Map the three ontologies to develop a comprehensive carbon data ontology for highway assets
- **Work package 2**– Break down the carbon data requirements into metadata points
- **Work package 3**- Build a carbon data model with the comprehensive carbon data ontology and carbon metadata requirements, and standardised structure
- **Work package 4**– Develop a data system prototype based on the carbon data model
- **Work package 5** - Identify a use case to test the methodology

How would you like to contribute?

(Please email Dr. Jinying Xu at jx314@cam.ac.uk)

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References

1. **Xu J.**, MacAskill K., Yin M. Zhu J. Brilakis I. (2024). Information requirements over the asset lifecycle to include carbon into digital twin: A UK highway example. *CIB W78/buildingSMART International Summit*. Marrakesh, Morocco.